

SECTION 253513
VALVE MOTOR OPERATORS

PART 1 - GENERAL

101. EXTENT

101.1 This Section prescribes the minimum requirements for motor operated valve actuators and associated accessories to be provided by the CONTRACTOR pursuant to this Contract. Said motor operated valve actuators and associated accessories shall conform to the requirements of this Section and to the requirements indicated on the design drawings.

102. RELATED WORK SPECIFIED IN OTHER SECTIONS

102.1 The work specified in other sections shall be coordinated with work specified in the following sections:

- a. Section 014219 – Reference Documents.

103. DESIGN REQUIREMENTS

103.1 Each motor operated valve actuator supplied by the CONTRACTOR shall include the motor, actuator unit gearing, position switch gearing, local valve position indicator, provisions for manual operation, and the specified number of torque and position switches. When the stem driving mechanism of the valve is not utilized, the actuator shall include a stem nut for rising stem valves or a bored and keyed drive sleeve for non-rising stem valves. Stem nuts shall have a positive locking feature to prevent loosening during valve travel.

103.2 Each valve actuator shall include a control station, solenoid operated brake, and position transmitter.

103.3 The valve actuator control shall be capable of fully seating the valve leaktight under electrical operation without jamming or requiring extremely accurate position switch adjustment. Gate and globe valves shall be seated under torque control. Butterfly, plug, and parallel disc gate valves shall be seated under position switch control.

103.4 Complete closure and release after closure of the valves shall not be dependent upon any variations of travel due to expansion, contraction, etc., and there shall be no damage to either the valve or the actuator.

103.5 The valve and its actuator shall be protected against damage if operated electrically or manually with an obstruction lodged in the valve under normal operation.

103.6 A means of preventing overtravel due to inertia of the valve actuator drive shall be provided which shall be operative in stopping the valve at the open, closed, or any intermediate position.

103.7 Manual operation of the valve shall be by a handwheel. Manual operation shall be initiated by operating a declutching lever, or by automatically declutching. This shall mechanically disengage the motor and its gearing. The actuator shall stay in the manual position until energized electrically. The motor shall not rotate during manual operation. The handwheel shall not rotate during motor operation. A fused motor or failed motor bearing shall not prevent manual operation.



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- 103.8 The valve actuator shall include a way of delivering a hammer blow to start either a closing or opening motion. It shall allow the motor to reach full speed before load is applied. This feature shall not be required for valves used in inching, throttling, modulating, or regulating service.
- 103.9 Valve actuator assemblies shall be designed to minimize the erection time in the field, with due consideration being given to the facilities at Purchaser's station.
- 103.10 Any valve actuator part subject to wear or likely to require renewal shall be designed to comply with a definite tolerance to ensure the part will be readily removable and replaceable with a minimum of work in the field.
- 103.11 All valve actuator metal parts, including screws, bolts, nuts, springs, studs, etc., shall be made of a corrosion resistant material or provided with a corrosion resistant finish.
- 103.12 A valve stem cover shall be provided where required.
- 103.13 Valve actuator equipment of the same type and rating, shipped under the same contract, shall be physically and functionally interchangeable.
104. REFERENCE DOCUMENTS
- 104.1 The standards, specifications, manuals, codes and other publications of nationally recognized organizations and associations are referenced herein. Methods, equipment and materials specified herein shall comply with the specified and applicable portions of the referenced documents, in addition to federal, state or local codes having jurisdiction. References to these documents are to the latest issue date of each document identified in Section 014219, unless otherwise indicated, together with the latest additions, addenda, amendments, supplements, thereto, in effect as of the date indicated in Section 014219.
- 104.2 ASTM International (ASTM; formerly American Society for Testing and Materials):
- a. F1030 - Standard Practice for Selection of Valve Operators.
- 104.3 AWWA - American Water Work Association:
- a. C540 - Power-Actuating Devices for Valves and Sluice Gates.
- 104.4 NFPA - National Fire Protection Association:
- a. 70 - National Electrical Code.
- 104.5 UL - Underwriters Laboratories, Inc.:
- a. 429 - Standard for Electrically Operated Valves.
- 104.6 NEMA - National Electrical Manufacturers Association:
- a. MG1 - Motors and Generators.
- b. ICS 1 - General Standards for Industrial Control Systems.
- c. ICS 2 - Industrial Control Devices, Controllers, and Assemblies.



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105. SUBMITTALS

- 105.1 The CONTRACTOR shall submit the following documents for review in accordance with the submittal requirements:
- a. Outline drawings of each motor operated valve actuator.
 - b. Location and sizes of valve actuator terminal boxes and conduit entrances.
 - c. Complete valve actuator wiring diagrams showing all wiring connections for all equipment furnished by CONTRACTOR. These diagrams shall also show limit switch and torque switch developments. Unless agreed to by the Consulting Engineers, the wiring connections shall conform with the appropriate schematic diagrams in this Specification. Connections to external wiring shall be shown at terminal blocks and each lead shall be properly identified.
 - d. Motor nameplate data for each valve actuator.
 - e. Performance curves for each valve actuator motor rating to be furnished with the equipment specified.
 - f. Maximum allowable torque switch settings and recommended torque switch settings for each valve actuator.
 - g. Other detail drawings and data as the DISTRICT Engineers may require for each valve actuator.
- 105.2 The Contract price shall cover a reasonable amount of changes in drawings incident to rearrangements of equipment to meet the DISTRICT Engineers' requirements.
- 105.3 The review of drawing and data shall not relieve the CONTRACTOR from furnishing equipment to the Purchaser that will control and operate the valve satisfactorily.
- 105.4 The CONTRACTOR shall furnish the Consulting Engineers with instruction books, descriptive bulletins, and spare parts bulletins, supplemented by working drawings of important concealed equipment for all equipment furnished. These shall be in addition to those shipped with the equipment for construction purposes, and they shall be sent to the Consulting Engineers at least four weeks prior to shipment of the equipment.

PART 2 – PRODUCTS

201. ACCEPTABLE MANUFACTURERS AND PRODUCTS

- 201.1 Refer to section 012513 – Acceptable Suppliers and Product Substitutions. (Couldn't find "Valve Motor Operators" on the list.)

202. COMPONENTS

- 202.1 Gearing:
- a. Where required, the valve actuator power gearing shall consist of generated helical gears or generated helical gears and worm gearing. The generated helical gears shall be of heat treated steel. The worm shall be of carburized and hardened alloy steel with threads ground after heat treating. The worm gear shall be of alloy bronze cut with a hobbing machine.
 - b. Ball or roller bearings shall be used throughout the valve actuator main power train.



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- c. The valve actuator final gear drive shall have a self-locking design, to prevent relaxation of the valve gearing after torque seating, except where unusually fast valve operation is required which would prohibit this feature.
- d. All lubricants required for any portion of the valve actuator shall be indicated on the valve actuator drawings or instruction manuals, and shall be suitable for the range of ambient temperature, pressure and humidity.
- e. The valve actuator construction shall be such that it can be mounted in any position and cause no problems of leakage of lubricant. Means shall be provided to prevent any lubricant from entering any portion containing electrical equipment.
- f. If oil is used as a lubricant for the valve actuator, means for filling and draining shall be provided.

202.2 Motors:

- a. Motors shall be horizontal or vertical, as required, single-speed, squirrel-cage induction type, 460V, 3-phase, 60 Hz and dc motors shall be rated 125V dc.
- b. The valve actuator motor shall be high torque, totally enclosed, non-ventilated (TENV) or fan cooled (TEFC), specifically designed for valve actuator service. The motor shall develop sufficient torque to operate the valve at a maximum ambient temperature of 40°C.
- c. The valve actuator motor shall preferably be pre-lubricated. All bearings shall be of the anti-friction type. Bearings shall be mounted so as to facilitate replacement and maintenance. If lubrication is required during the life of the motor, it shall be accomplished without removal of bearing caps. No special lubricants shall be required up to an ambient temperature of 150°F.
- d. The valve actuator motor shall be designed, built, and adequately braced for across-the-line starting.
- e. Direct current motors will be considered as having unsatisfactory commutation under normal load and normal voltage if noticeable visible sparking occurs, or if visible sparking occurs over more than half the brush width.
- f. With an ambient temperature of 40°C, the temperature rise by resistance of the valve actuator motor windings and parts shall not exceed 85°C (for TENV) or 80°C (for TEFC) after three continuous complete closing and opening cycles of the valve.
- g. The valve actuator motor insulation shall be as a minimum NEMA Class B and shall be adequate for the specified environmental and service conditions.
- h. Shaft and bearing housings shall be constructed with oil deflectors and seals, so that lubricant will not leak along the shaft or be thrown into the valve actuator motor windings.
- i. The valve actuator motor shall be mounted so that it will be unaffected by excessive temperatures on the valve and so that steam, water, or other leakage due to packing failure cannot harm the valve actuator electrical equipment.
- j. The motor shall be sized to open or close the valve against the maximum specified differential pressure, without damage, when the voltage at its terminal varies plus 10 percent and minus 20 percent of rated voltage for ac motors.
- k. The motor shall be sized to open or close the valve against the maximum specified differential pressure, without damage, when the voltage at its terminals varies plus or minus 30 percent of

rated voltage for dc motors. DC motors will be considered having unsatisfactory commutation under normal load and normal voltage if noticeably visible sparking occurs, or if visible sparking occurs over more than half the brush width.

202.3 Stem Nut:

- a. The valve actuator shall have a removable stem nut of high tensile bronze, ductile iron, or other material compatible with the valve stem. When the stem driving mechanism of the standard valve is not utilized, the operating unit stem nut arrangement shall be of the two-piece type, if possible, to simplify replacement.

202.4 Position Switch:

- a. Valve actuator position switches, referred to as limit switches in attached Figure 1-1 through 1-5, shall be furnished in both the open and closed directions of valve travel. The switches shall be adjustable.
- b. The valve actuator position switches shall serve to stop the valve travel, where appropriate, at full open or full closed, to bypass torque switches, to operate indicating lamps that shall show valve position and to operate sequencing of interlock circuits, where appropriate.
- c. The valve actuator position switches shall be mechanically connected to the moving valve stem and shall be in step at all times while the valve is being operated electrically or manually. Operation of the handwheel shall not change the set-points of the limit switches.
- d. The valve actuator position switches shall have wiping contacts with a minimum interrupting rating at 250 Vdc of an inductive load of 0.25A. The continuous current rating shall be suitable for the operating requirements of the valve actuator control. The switches shall have a minimum voltage rating of 600 V.
- e. The CONTRACTOR shall state in his Proposal the manufacturer and type of valve actuator position switches to be furnished. If requested by the Consulting Engineers, he shall submit a sample and supporting data for review.

202.5 Torque Switch:

- a. Valve actuator torque switches shall be furnished for stopping the motor in its extreme operating position and to protect the motor if foreign objects are encountered during either a closing or opening operation. They shall be separately adjustable.
- b. The valve actuator torque switches shall have wiping contacts with a minimum interrupting rating at 250 Vdc of an inductive load of 0.25A. The continuous current rating shall be suitable for the operating requirements of the valve actuator control. The switches shall have a minimum voltage rating of 600 V.
- c. The CONTRACTOR shall provide the recommended valve actuator torque switch settings.
- d. The CONTRACTOR shall state in his Proposal the manufacturer and type of valve actuator torque switches to be furnished. CONTRACTOR shall submit a sample and supporting data for review.

202.6 Valve Position Indicator:

- a. A mechanically operated valve position indicator shall be provided on each valve actuator to give an indication of position at all times. It shall be located so as to be readily visible from a distance.

- 202.7 Reversing Motor Starter:
- a. All motor operators shall be connected to DISTRICT's supplied starter located in a motor control center.
 - b. Each valve actuator shall be provided with an integral disconnect switch to isolate the actuator from the incoming 3-phase power supply. Switch enclosure shall be rated the same as the actuator enclosure. The CONTRACTOR shall provide the disconnect switch rating.
- 202.8 Solenoid Brake:
- a. If required for satisfactory operation of the valve or if required by this Specification, a spring applied, solenoid released brake shall be provided for the valve actuator. The drum shall be directly coupled to the motor shaft.
 - b. The valve actuator solenoid brake shall operate over the specified range of motor voltages. It shall be capable of continuous operation at an ambient temperature of 40°C, unless other ambient conditions are stated in this Specification.
- 202.9 Control Station:
- a. A control station for the valve actuator shall be furnished. Its enclosure shall be in accordance with this Specification. It shall be of the three button type with red and green indicating lamps. The buttons shall be marked "OPEN," "STOP," and "CLOSE." A card holder shall be provided for each station.
- 202.10 Position Transmitter:
- a. When called for in the Specification, a position transmitter for the valve actuator shall be furnished. Equipment shall be of the electrical type, suitable for operation at 120 Vac. The transmitter shall be totally enclosed, and shall be directly connected or geared to the valve stem, and it shall remain in synchronism during both manual and motor operation. The indicator will be furnished by the Purchaser.
- 202.11 Schematic Control Diagram:
- a. The valve actuator control scheme shall be essentially as shown in the following figures. It may be modified to meet the manufacturer's standard, provided that essential features are retained and such modification is agreed to by the Consulting Engineers.
 - a1. Figure 1 - Limit and Torque Switch Development
 - a2. Figure 3 - Gate or Globe Valve Actuator with Locking Gears (Throttling and Non-Throttling)
 - a3. Figure 7 - Butterfly, Plug, or Parallel Disc Gate Valve Actuator (Throttling and Non-Throttling)
- 202.12 Wiring:
- a. Control and power wiring for the valve actuator shall be No. 14 AWG (16 AWG is acceptable for control wiring if it is manufacturer's standard) except where larger size conductors are needed for current carrying requirements in accordance with ANSI standards. The conductors shall be stranded copper. The conductors shall have 600 V, 90°C, flame retardant cross-linked polyethylene insulation.

- b. The assembled valve actuator control equipment and wiring connections shall be insulated for a working voltage of 600 V, and shall be subjected to dielectric tests in accordance with NEMA Standard ICS 1, Section 109.21, at the factory, after fabrication and assembly is complete.
- c. Screw type terminals with washer head screws shall be provided for terminating all control and instrumentation wiring for the valve actuator. Barriers between terminals shall be of such height that terminal screws or wire lugs will not project above the barriers. Space between barriers shall be sufficient to accommodate Purchaser's lugs, which will not exceed 3/8-inch in width. Terminals shall be clearly and permanently identified. Terminals shall have a minimum voltage rating of 600 V.
- d. The CONTRACTOR shall label all valve actuator terminals for the DISTRICT's incoming cable connections to correspond with the Consulting Engineers' requirements.
- e. All valve actuator internal control wiring terminations shall be made with ring-tongue type compression lugs.
- f. Single hole compression type terminal lugs shall be attached to the valve actuator motor winding terminal leads for connection to DISTRICT's cable. Lugs for DISTRICT's cable will be furnished by others. The opening through which the motor winding terminal leads pass shall be rounded off and smoothly finished or provided with a suitably protected passageway that will not cause an abrasive action on the motor lead insulation.
- g. Valve actuators shall be furnished with an oversized enclosure, where required, to allow a 1/2 in. minimum bending radius of individual conductors in DISTRICT's incoming control cables.

203. SOURCE QUALITY CONTROL

203.1 Inspections and Tests:

- a. The DISTRICT shall have the right to inspect all valve actuator equipment covered by this Specification at any time during its manufacture and assembly, and shall have the right to be present during any tests made on the equipment.

204. PREPARATION FOR SHIPPING

204.1 Packaging and Shipping:

- a. The equipment shall be packed, crated, and rigidly braced to protect it from damage during shipment, handling, and from the weather.
- b. Assemblies shall be such that they will minimize the erection time in the field, with due consideration being given in handling facilities at Purchaser's station.
- c. The identity of the contents shall be clearly marked on the exterior of packaged units, along with the Specification Number, Valve Number, and the Purchase Order Number. In addition, each valve shall be furnished with a metal tag labeled per this Specification's requirements.
- d. The CONTRACTOR shall furnish the DISTRICT with the necessary storage instructions required to maintain the original condition of the equipment, before installation and until the equipment is placed in service.



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205. FINISH REQUIREMENTS

- 205.1 The exterior surface of the valve actuator shall be thoroughly cleaned, filled where necessary and given a coat of manufacturer's standard primer and a finish coat of the manufacturer's standard paint.

PART 3 – EXECUTION

Not Used.



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FIGURE 1

LIMIT AND TORQUE SWITCH DEVELOPMENT

LIMIT SWITCH (LS) AND TORQUE SWITCH (TS) DEVELOPMENT (FOR VALVE ACTUATOR WITH SEPARATE LIMIT AND TORQUE SWITCHES)						
CONTACTS	SYMBOL	VALVE POSITION			CONTACT FUNCTION	ROTOR
		FULL OPEN	INTERMEDIATE	FULL CLOSED		
1 - 1C	LS/O	—			TSC BYPASS	1
2 - 2C	LS/O	—				
3 - 3C	LS/IC		—	—	OPEN LIMIT	
4 - 4C	LS/IC		—	—	GREEN LIGHT	
5 - 5C	LS/C			—		2
6 - 6C	LS/C			—		
7 - 7C	LS/IO	—	—			
8 - 8C	LS/IO	—	—		RED LIGHT	
9 - 9C	LS/O	—				3
10 - 10C	LS/O	—				
11 - 11C	LS/IC		—	—		
12 - 12C	LS/IC		—	—		
13 - 13C	LS/C			—	TSO BYPASS	4
14 - 14C	LS/C			—		
15 - 15C	LS/IO	—	—			
16 - 16C	LS/IO	—	—			
17 - 17C	TSC	SEE LEGEND			CLOSING TORQUE SWITCH	-
18 - 18C	TSO	SEE LEGEND			OPENING TORQUE SWITCH	-

LEGEND:

- O - CONTACT CLOSED WHEN VALVE IS FULLY OPEN
- IO - CONTACT CLOSED WHEN VALVE IS IN INTERMEDIATE OR FULLY OPEN POSITION
- C - CONTACT CLOSED WHEN VALVE IS FULLY CLOSED
- IC - CONTACT CLOSED WHEN VALVE IS IN INTERMEDIATE OR FULLY CLOSED POSITION
- TSC - CONTACT OPENS IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE
- TSO - CONTACT OPENS IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE
- - DENOTES CONTACT CLOSED

NOTE: - THE ROTORS MAY BE INDEPENDENTLY SET AT ANY POSITION OF TRAVEL.
THE SCHEMATIC DIAGRAMS IN THIS SPECIFICATION ARE BASED ON SETTING ROTORS 3 AND 4 AT INTERMEDIATE POSITIONS OF TRAVEL.



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FIGURE 1 (CONT.)

LIMIT AND TORQUE SWITCH DEVELOPMENT

LIMIT AND TORQUE SWITCH DEVELOPMENT (FOR VALVE ACTUATOR WITH COMBINED LIMIT AND TORQUE SWITCHES)						
CONTACTS	SYMBOL	VALVE POSITION			CONTACT FUNCTION	LIMIT SWITCH PACK
		FULL OPEN	INTERMEDIATE	FULL CLOSED		
24 - 25	OTLS/IC				COMBINED OPENING TORQUE AND LIMIT SWITCH	
26 - 27	CTLS/IO				COMBINED CLOSING TORQUE AND LIMIT SWITCH	
6 - 7	LS/C					
8 - 9	LS/IO				RED LIGHT	
15 - 16	LS/O					
17 - 18	LS/IC				GREEN LIGHT	
10 - 11	LS/O					ADD-ON-PAK 1
12 - 13	LS/O					
19 - 20	LS/IC					
21 - 22	LS/C					ADD-ON-PAK 1
28 - 29	LS/C					
30 - 31	LS/IO					

LEGEND:

- O - CONTACT CLOSED WHEN VALVE IS FULLY OPEN
- IO - CONTACT CLOSED WHEN VALVE IS IN INTERMEDIATE OR FULLY OPEN POSITION
- C - CONTACT CLOSED WHEN VALVE IS FULLY CLOSED
- IC - CONTACT CLOSED WHEN VALVE IS IN INTERMEDIATE OR FULLY CLOSED POSITION
- CTLS - CONTACT OPENS ON POSITION OR IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE
- OTLS - CONTACT OPENS ON POSITION OR IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE
- - DENOTES CONTACT CLOSED

NOTE: - THE LIMIT SWITCH PACKS MAY BE INDEPENDENTLY SET AT ANY POSITION OF TRAVEL.



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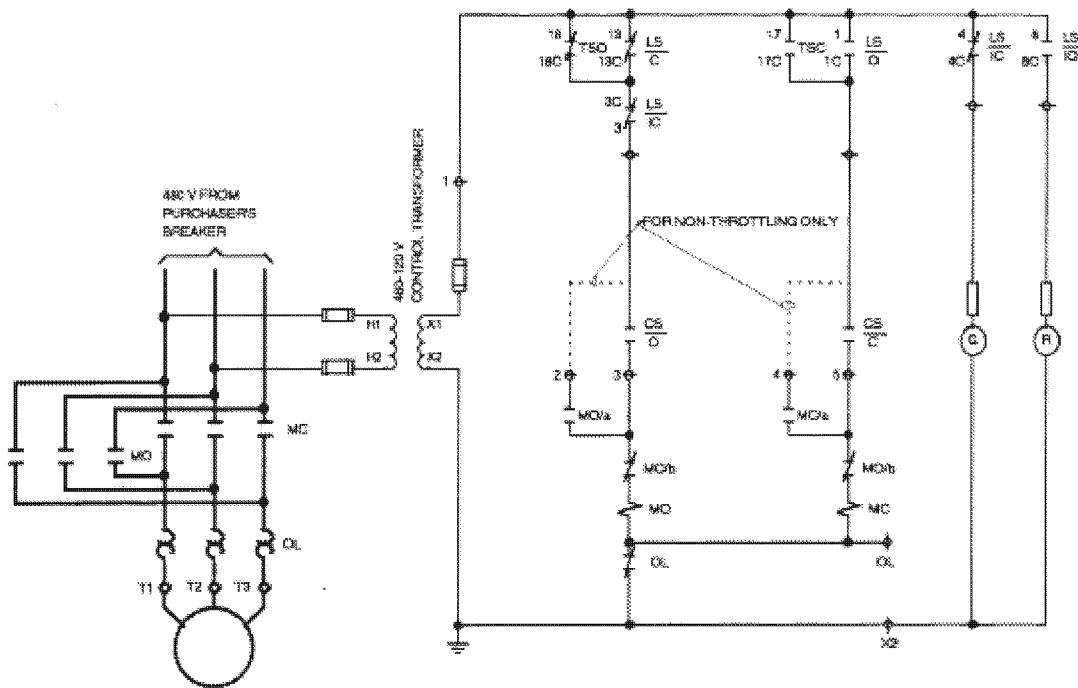
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FIGURE 3
SCHEMATIC DIAGRAM FOR GATE OR GLOBE VALVE ACTUATORS
WITH LOCKING GEARS AND SEPARATE LIMIT AND TORQUE SWITCHES
(THROTTLING AND NON-THROTTLING)



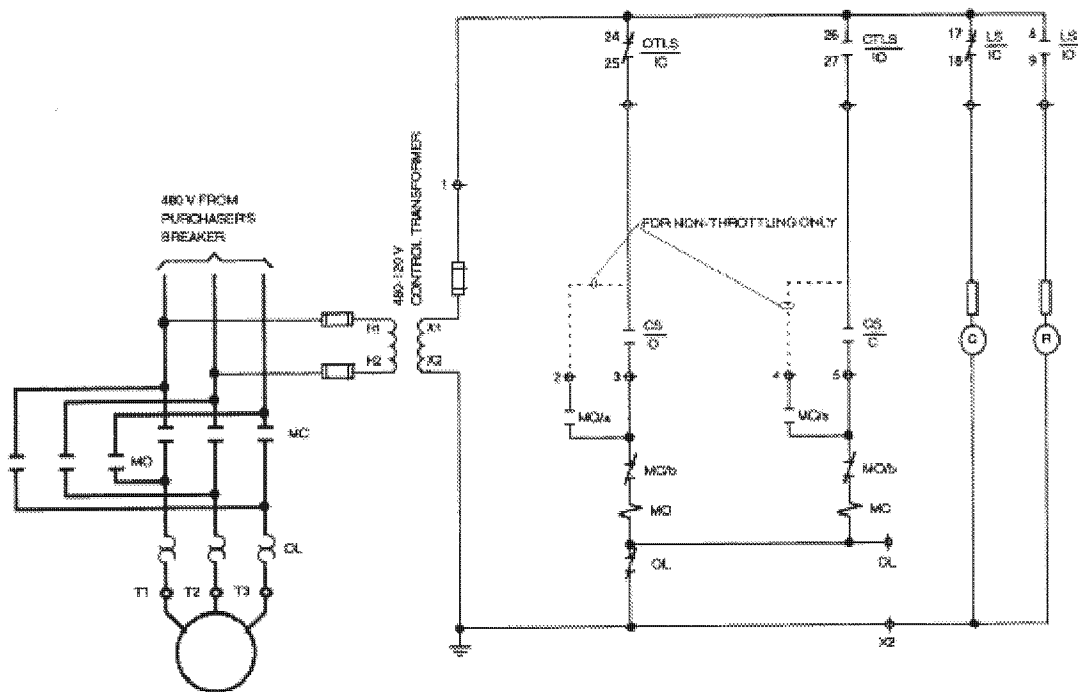
LEGEND:

- NO - OPEN CONTACTOR
NC - CLOSE CONTACTOR
TSC - CLOSING TORQUE SWITCH, INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE
TSC - OPENING TORQUE SWITCH, INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE
LS - LIMIT SWITCH
CS - CONTROL SWITCH
D - OPEN
C - CLOSE
OL - OVERLOAD

NOTE: THE LIMIT AND TORQUE SWITCHES ARE SHOWN WITH THE VALVE IN THE FULLY CLOSED POSITION.

FIGURE 3 (CONT.)

SCHEMATIC DIAGRAM FOR GATE OR GLOBE VALVE ACTUATOR
 WITH LOCKING GEARS AND COMBINED LIMIT AND TORQUE SWITCHES
 (THROTTLING AND NON-THROTTLING)

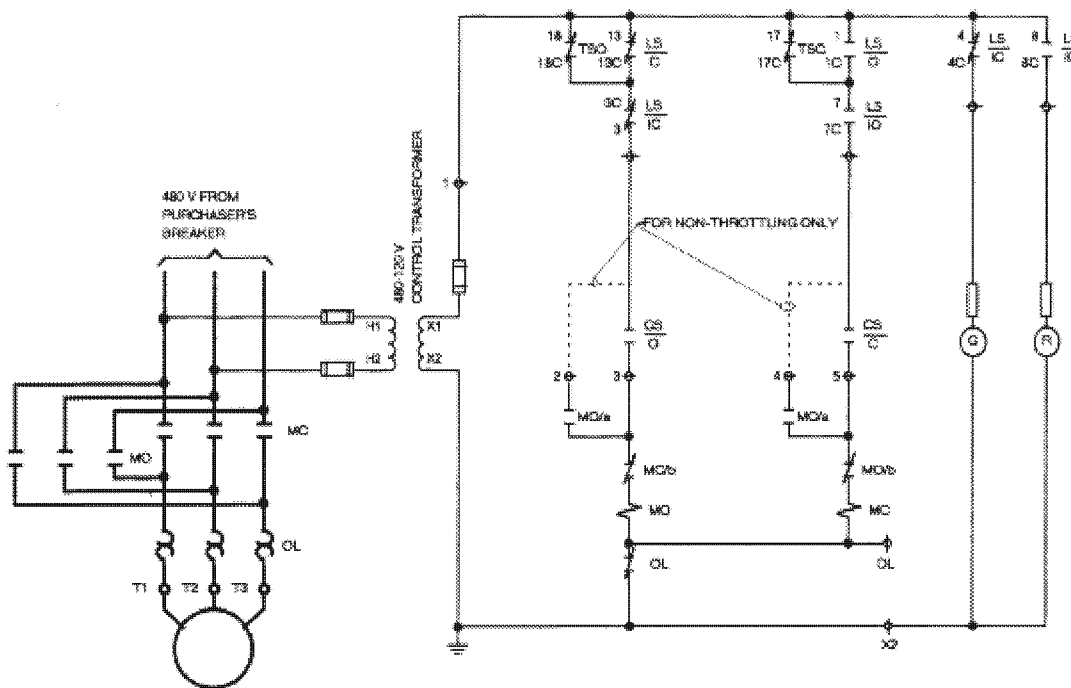


LEGEND:

- MO - OPEN CONTACTOR
 - MC - CLOSE CONTACTOR
 - OTLS - COMBINED OPENING TORQUE AND LIMIT SWITCH. INTERRUPTS CONTROL CIRCUIT ON POSITION OR IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE
 - CTL - COMBINED CLOSING TORQUE AND LIMIT SWITCH. INTERRUPTS CONTROL CIRCUIT ON POSITION OR IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE
 - LS - LIMIT SWITCH
 - CS - CONTROL SWITCH
 - O - OPEN
 - C - CLOSE
 - OL - OVERLOAD
 - - TERMINAL AT STARTER TERMINAL BLOCK
- NOTE: THE LIMIT AND TORQUE SWITCHES ARE SHOWN WITH THE VALVE IN THE FULLY CLOSED POSITION

FIGURE 7

SCHEMATIC DIAGRAM FOR BUTTERFLY, PLUG, OR PARALLEL DISC GATE
 VALVE ACTUATOR WITH SEPARATE LIMIT AND TORQUE SWITCHES
 (THROTTLING AND NON-THROTTLING)



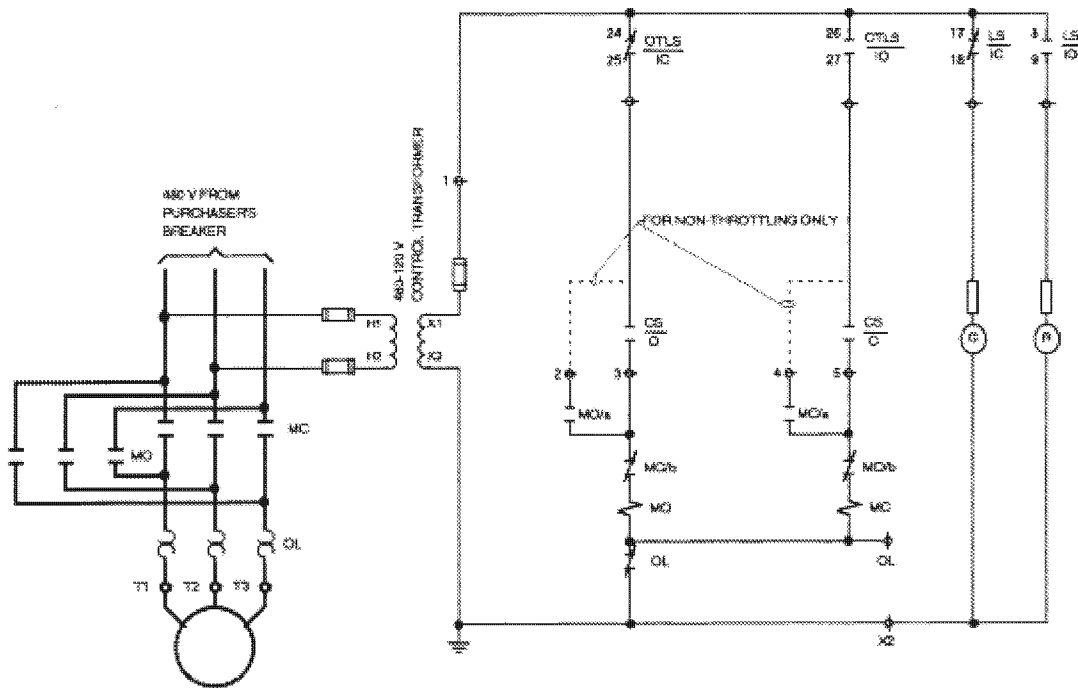
LEGEND:

- MO - OPEN CONTACTOR
- MC - CLOSE CONTACTOR
- TSC - CLOSING TORQUE SWITCH, INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE
- TSO - OPENING TORQUE SWITCH, INTERRUPTS CONTROL CIRCUIT IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE
- LS - LIMIT SWITCH
- CS - CONTROL SWITCH
- O - OPEN
- C - CLOSE
- OL - OVERLOAD
- ◆ - TERMINAL AT STARTER TERMINAL BLOCK

NOTE: THE LIMIT AND TORQUE SWITCHES ARE SHOWN WITH THE VALVE IN THE FULLY CLOSED POSITION.

FIGURE 7 (CONT.)

SCHEMATIC DIAGRAM FOR BUTTERFLY, PLUG, OR PARALLEL DISC GATE
 VALVE ACTUATOR WITH COMBINED LIMIT AND TORQUE SWITCHES
 (THROTTLING AND NON-THROTTLING)



LEGEND:

- MO - OPEN CONTACTOR
 - MC - CLOSE CONTACTOR
 - OTLS - COMBINED OPENING TORQUE AND LIMIT SWITCH. INTERRUPTS CONTROL CIRCUIT ON POSITION OR IF MECHANICAL OVERLOAD OCCURS DURING OPENING CYCLE
 - CTLS - COMBINED CLOSING TORQUE AND LIMIT SWITCH. INTERRUPTS CONTROL CIRCUIT ON POSITION OR IF MECHANICAL OVERLOAD OCCURS DURING CLOSING CYCLE
 - LS - LIMIT SWITCH
 - CS - CONTROL SWITCH
 - O - OPEN
 - C - CLOSE
 - OL - OVERLOAD
 - - TERMINAL AT STARTER TERMINAL BLOCK
- NOTE: THE LIMIT AND TORQUE SWITCHES ARE SHOWN WITH THE VALVE IN THE FULLY CLOSED POSITION.

END OF SECTION